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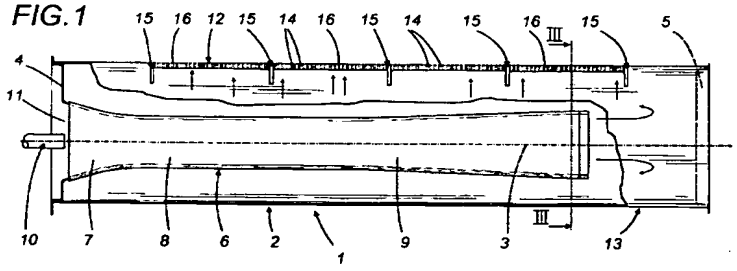
(54) Gas burner

(57) The invention relates to a gas burner (1) either of the atmospheric or premix type comprising a casing (2, 102) in the shape of a tube or of a ramp and enclosing a mixing element (6) capable, when used, of creating a mixture of gas and air inside the casing (2, 102); in the portion (12) of the wall (13) defining the lateral surface of the casing (2, 102) there is a plurality of first flame ports (14) designed to allow the combustion mixture of gas and air out of the casing (2, 102) and there is also at least one second port (15, 15t) consisting of a structural break, preferably a slot, substantially perpendicular to the longitudinal axis (3) of the casing (2, 102).

FIG.1



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Description

The present invention relates to a gas burner, either of the atmospheric or premix type.

The invention relates in particular to a gas burner with a high resistance to stress resulting from thermal expansion.

Gas burners known in prior art may be divided into two categories, namely, atmospheric burners and premix burners.

Atmospheric burners usually comprise a tubular casing, closed at both ends and coaxially enclosing a venturi tube consisting of a converging portion, a cylindrical throat and a diverging portion. The venturi tube may be a separate part fitted in the burner or it may form an integral part of the burner itself, made, for example, by die forming or other known methods.

The said tubular casing has a plurality of flame ports, usually at the top, designed to allow a combustion mixture of gas and air to flow out of it.

A nozzle injects gas into the opening of the venturi tube and, in accordance with the known principles of fluid mechanics, a certain quantity of air is also sucked into the opening of the venturi tube and mixes well with the gas in the aforesaid cylindrical throat The gas/air mixture, in the desired and controlled stoichiometric proportions, is then dynamically compressed in the said diverging portion, is discharged into the tubular casing and allowed through the said flame ports into the atmosphere where it is burnt.

Other known types of atmospheric gas burners envisage only a throat and a diverging section or even just a tube-shaped section.

Besides tubular burners (of both atmospheric and premix types, described below), prior art also knows modular "blade type" burners, where a single, integral structure constitutes both the casing of the burner and its functional parts as described above for tubular burners; flame ports designed to allow the gas/air mixture into the atmosphere where it is burnt are made in this structure at suitable locations.

In premix gas burners, on the other hand, the gas and air are supplied by means (consisting typically of fans and mixers) which, in a manner similar to that achieved by the venturi device described above, create a premixture of gas and air outside the tubular casing and supply the combustion mixture to the aforesaid flame ports.

The mixture is ignited through auxiliary systems that do not form part of the subject-matter of the present invention.

The configuration and size of the aforesaid ports are such as to prevent the flame from returning into the tubular casing of the burner but to keep it adjacent to the outer surface of the casing. The flame ports may assume many different sizes and configurations. For example, they may be continuous rows of slits or groups of slits arranged in chequered fashion, offset with respect to each other, or they may be appropriately distributed holes or combinations of slits and holes distributed in any of various different ways, made in a lateral portion (which may even coincide with the entire lateral surface) of the tubular casing which will hereafter be referred to as the "flame port area".

The distance of the flame front from the surface of the tubular casing depends on the type of gas used, on the gas supply pressure and on the shape of the burner. In all cases, because of the nearness of the flame to the said tubular casing, a portion of the tubular casing itself (namely, the flame port area), depending on the type and category of the burner, reaches extremely high temperatures, with peaks of up to 600°C and over. In particular, under certain operating conditions, not frequent in well designed and constructed burners but always possible even in these, the temperature of at least part of the wall of the tubular casing (that around the flame port area) may become so high as to produce considerable deformation, resulting in stress and strain, in particular on the sides of the tubular casing. This deformation, if excessive in that it is normally prevented, is permanent and may lead to burner breakage or malfunctioning even when the overheating ceases. In some cases, such deformation may also make it dangerous to continue using the burner, producing a risk of serious damage to the apparatus where it is fitted or even to the room where it is used.

The aim of the present invention is to overcome the disadvantages mentioned above by providing a burner capable of resisting abnormally high temperatures without being permanently deformed and without reducing its efficiency or giving rise to hazardous situations.

The invention as characterized in the claims below, overcomes the abovementioned disadvantages by providing a gas burner of the type comprising a casing that encloses a mixing element capable, when used, of creating a mixture of gas and air inside the casing, there being made in a portion of the wall defining the lateral surface of the said casing a plurality of first flame ports defining a flame port area and designed to allow the combustion mixture of gas and air out of the casing, characterized in that the said portion has, in the flame port area, at least one second port consisting of a structural break, preferably a slot, substantially perpendicular to the longitudinal axis of the said casing.

The said burner preferably comprises a plurality of second ports consisting of slots parallel to each other and substantially perpendicular to the longitudinal axis of the said casing.

One of the advantages achieved by the present invention is basically that the burner casing (preferably of the tubular type), and in particular the part of it in and around the flame port area, can be subjected to extremely high temperatures without producing permanent deformations that can damage it or make its use dangerous.

The technical characteristics of the invention

according to the abovementioned aim are described in the claims below and its advantages are apparent from the detailed description which follows, with reference to the accompanying drawings which illustrate preferred embodiments of the invention and in which:

- Figure 1 is a schematic elevation view, partially in cross section, of a burner made in accordance with the present invention;
- Figure 2 is a schematic plan view of the burner illustrated in Fig. 1;
- Figure 3 is a cross section view of the burner illustrated in Figs.1 and 2 obtained by cutting the burner through a plane III-III, shown in Fig. 1;
- Figures 4, 5 and 6 illustrate alternative configurations of the flame ports for the air/gas mixture differing from the flame port area illustrated in Fig. 2.
- Figures 7, 8 and 9 illustrate an alternative embodiment of the burner shown in Figs. 1, 2 and 3, that is to say, a burner of the so-called modular blade type, in similar views, namely, an elevation view, a plan view and a side view from B;
- Figures 10 and 11 illustrate alternative configurations of the second ports, defined below. With reference to the accompanying drawings, the numeral 1 indicates a gas burner as a whole, represented in the atmospheric version by way of example only, without thereby restricting the scope of the inventive concepts which may be applied also to burners of the premix type.

The burner 1 comprises a tubular casing 2 extending lengthways along an axis 3 which, when the burner is in use, is horizontal. The tubular casing 2, in cross section, forms a closed shape (in the embodiment illustrated, see Fig. 3, it is substantially ovoid in shape) with one end, illustrated on the right in Fig. 1, closed by a vertical end cap 5 and the other end, on the left-hand side, being closed by a flange 4 with a gas and air inlet port. Inside the tubular casing 2, there is a mixing element consisting of a venturi tube 6 extending along an axis parallel to the axis 3 and comprising, from left to right in Fig. 1, a converging portion 7, a cylindrical throat 8 and a diverging portion 9.

A feeder element, consisting of a nozzle 10, faces the inlet port of the tubular casing 2 through a hole 11 made in the central portion of the flange 4 (the inlet port mentioned above), being fitted at the inlet of the converging portion 7 so that, under operating conditions, it can inject a stream of gas into the converging portion 7 according to known injector technology.

A lateral portion 12 of the wall 13 defining the tubular casing 2, the upper portion in the embodiment illustrated (see Fig. 3 in particular), has an area with a plurality of flame ports, starting at distances L1 and L2 from the ends of the tubular casing 2 and hereafter also referred to as "flame port area" 12a. In the embodiment illustrated in Fig. 2, the flame ports consist of a series of apertures 14 (preferably but not necessarily slits) parallel to each other and perpendicular to the aforesaid axis 3. These generic flame ports 14 (generic in shape and configuration but essential in that they act as outlets for the mixture to be burnt) may be arranged in any manner, typically along one or more adjacent longitudinal rows (see Fig. 4) or in shorter polygonal groups arranged in line or in chequered fashion (see Fig. 5) or, as mentioned in the introduction, they may be circular, as illustrated in Fig. 6.

The upper portion 12 of the wall 13 also has a plurality of structural breaks, consisting preferably (but not necessarily), as shown in the embodiments illustrated in the drawings, of second ports or slots parallel to each other, perpendicular to the axis 3 and, with reference to the lengthways direction of the tubular casing 2, being longer than the aforementioned flame ports 14, the length of the latter being measured in the direction orthogonal to the axis 3.

The width of the second ports 15, measured in the lengthways direction of the tubular casing 2, is such that, during use, whatever the operating temperature (normal or exceptional) of the burner 1, and hence whatever the degree of thermal expansion of the upper portion 12 (and sections adjacent to it, in particular the flame port area 12a) of the wall 13 that defines the lateral surface of the tubular casing 2, the two adjacent (or opposing) edges of each second port can never come into contact with each other.

There may be any number of second ports 15 (even a single second port 15 made at the line through the centre of the tubular casing 2) and the distance between two consecutive second ports 15 is preferably greater than the distance separating two consecutive flame ports 14.

Preferably, the second ports 15 are long enough to extend right across the area of the tubular casing 2 likely to reach excessive temperatures, that is to say, the aforementioned flame port area 12a, and in any case temperatures greater than the optimum operating temperature or any temperature significantly higher than that reached at the same time during use by the lower lateral portion of the wall 13.

In practice, the purpose of the structural breaks defining the said second ports 15 is to allow the free, unobstructed expansion of the portion of the lateral surface of the burner that is subjected to the highest temperatures. For this reason, the shape, number and distribution of the said second ports will depend on the design requirements of each burner, even though in the embodiments illustrated in Figs 1, 3, 7 and 8, the second ports are crossways slots perpendicular to the burner axis 3.

During use, the gas is injected into the venturi tube 6 through the nozzle 10 and entrains a flow of air through an appropriate port (not illustrated) made in the aforementioned flange 4. The streams of air and gas enter the converging portion 7 of the venturi tube 6

together and are well mixed before leaving the venturi tube 6 through the diverging portion 9. The gas/air mixture then leaves the tubular casing 2 through the flame ports 14 and is ignited by known means outside the tubular casing 2 adjacent to the flame ports 14.

When the burner 1 is cold, the tubular casing 2 has the nominal dimensions, depending on burner design, and is not subjected to stress.

When the gas and air mixture leaving through the flame ports 14 is ignited, the parts 16 of the upper portion 12 adjacent to the flame port area 12a and between each pair of consecutive second ports 15 (and between the walls 4 and 5 and the second ports 15 nearest to them) expand in the axial direction but this does not produce dangerous stress in the upper portion 12 since the presence of a second port 15 between each part 16 and the part 16 nearest to it, allows the parts 16 to expand freely. Indeed, as the temperature of the parts 16 changes, so the distance between opposite edges of the second ports 15 between pairs of consecutive parts 16 changes accordingly, that is to say, this distance decreases as the temperature rises and increases as the temperature falls.

Dangerous stresses are those which can give rise to peak strain on the structure (labelled 16) adjacent to the flame ports 14, causing the structure and the flame ports 14 themselves to deform. If the shape of the flame ports 14 is modified, there is the risk of the flame flashing back into the burner 1, thus reducing the efficiency of the entire burner 1 or even creating hazardous conditions during its operation.

However, thanks to the presence of the second ports 15 (which define a structural break in the wall 12) and in accordance with the concepts described above, the upper portion 12 of the tubular casing 2 remains free to expand lengthways in the axial direction and, therefore, the strain on the structure remains within safe limits whatever the temperature reached by the burner 1, since peak strain conditions are not produced because the axial expansion of the structure is not obstructed.

It has been found that having equipped the burner 1 with the second ports 15 makes it possible to almost entirely eliminate potentially damaging stress from the upper portion 12 even when the burning of the inflammable mixture causes the upper portion 12 to reach a temperature that is higher than the optimum operating temperature of the burner 1, as mentioned in the introduction above and/or that is in any case considerably different from the temperature reached by the lower lateral portion of the wall 13 at the same time.

From the above description, it is clear that the burner 1 fully achieves the abovementioned aims in that the structure of the burner 1 is capable of withstanding overheating without producing permanent deformations that can reduce burner efficiency or give rise to hazardous situations.

The number of the second ports 15, the spacing between them and their width (measured along the said axis 3) will obviously depend on the amount of expansion that is to be controlled and on the design of the tubular casing, the shape of the flame ports 14, the temperature differences expected between the hot and cold parts of the burner, the combustion chamber containing the burner, the materials used and so on. What is important is to be able to control the axial expansion of the flame port area 12a relative to the remaining portion of the tubular casing 2 so as to control the effect of the thermal expansion which the area 12a is subjected to as a result of the different temperature distribution on the tubular casing 2.

In another embodiment, the second port(s) may also be made in the front and/or rear part of the lateral portion 12, that is, in the section or sections before and/or after the flame port area (labelled L1 and L2 in the drawings). The additional second ports in this embodiment are labelled 15t in Fig. 2 and drawn with dashed lines.

In yet another embodiment, the second ports 15, which in the embodiment illustrated in Fig. 10, are circular and labelled 15c, may be closed by suitable heat-resistant baffles 15s (attached, for example, to one side of the tubular casing at 15f) to prevent the mixture from issuing out of the said second ports. In other terms, where the size and shape of the second ports 15c are such that there is the risk of the flame flashing back through them, such ports can be closed by an appropriately fitted piece of metal plate designed to prevent or significantly reduce the passage of mixture but without obstructing the expansion of the parts of the tubular casing as described above. The purpose of this is to prevent excessive quantities of unburnt mixture and/or undesirable emissions in the flue gases.

As stated above, the inventive concepts described can be applied also to premix burners in a manner obvious to an expert in the trade in the light of the above description. The dashed line in Fig. 2 indicates the generic element 6p for premixing the gas and air mixture outside the tubular casing 2, the said mixture being then forced into the tubular casing under pressure to reach the combustion area.

The invention described can be subject to modifications and variations without thereby departing from the scope of the inventive concept.

For example, the detail labelled V in Fig. 2 shows one possible variation of the invention in which each of the said second ports 15 is divided into smaller ports (15') arranged one after the other along a curved line perpendicular to the axis 3 and separated from each other by very small portions of the wall 13.

Another variation, which well represents the different shapes and distributions that may be assumed by the second ports 15, is illustrated in Fig. 11. In this case, the second ports consist simply of a crossways slot separating two contiguous parts of the flame port area 12a, of one or more holes 15n made just outside the flame port area and defining the part 16, or of a combination

of these.

The invention can also be similarly applied to non-tubular burners, that is, to modular blade type burners, illustrated by way of example in Figs. 7 to 9 which show such burners in the atmospheric version, the application to premix burners of this type being obvious. The reference numbers labelling the parts of the burner illustrated in Figs 7 to 9 are the result of adding one hundred to the reference numbers of the corresponding parts in Figs. 1 to 3.

Moreover, all the details of the invention may be substituted by technically equivalent elements.

Claims

1. A gas burner either of the atmospheric or premix type comprising a casing (2, 102) that encloses a mixing element (6) capable, when used, of creating a mixture of gas and air inside the casing (2, 102); there being made in a portion (12) of the wall (13) defining the lateral surface of the said casing (2, 102) a plurality of first flame ports (14) defining a flame port area (12a) and designed to allow the combustion mixture of gas and air out of the casing (2, 102), characterized in that the said portion (12) has, in the flame port area (12a), at least one second port (15, 15t, 15c, 15m, 15n) consisting of a structural break designed to allow overheating of the said portion without permanent deformation in and around the said portion.

2. The burner according to claim 1 characterized in that it comprises a plurality of second ports (15, 15t, 15c, 15m, 15n) consisting of structural breaks designed to allow overheating of the said portion without permanent deformation in and around the said portion, the said second ports (15, 15t, 15c, 15m, 15n) being distributed along the flame port area (12a).

3. The burner according to claim 1 characterized in that the number of the said second ports (15, 15t, 15c, 15m, 15n), the spacing between them and their width, measured in a direction parallel to the said axis (3), depend on the amount of expansion, during use, of the part of the casing (2, 102) in which the said first flame ports (14) are made and which is to be controlled and also on the design of the casing (2, 102), on the shape of the first flame ports (14), on the materials used and on the temperature conditions of the combustion chamber in which the burner is used.

4. The burner according to any one of the claims from 1 to 3 characterized in that the said first flame ports consist of slits (14) parallel to each other and perpendicular to the longitudinal axis (3) of the casing (2, 102).

5. The burner according to claims 1 to 3 characterized in that the second ports (15, 15t, 15m) consist of slots that are substantially perpendicular to the longitudinal axis (3) of the casing (2, 102).

6. The burner according to claim 4 characterized in that the second ports (15, 15t) consist of slots and, with reference to the lengthways direction of the tubular casing (2, 102), are longer than the aforementioned first flame ports (14).

7. The burner according to claims 1 to 3 characterized in that the second ports (15c) are circular and closed by heat-resistant baffles 15s attached to one side of the tubular casing (2, 102) to prevent the mixture from issuing out of the said second ports (15c).

8. The burner according to claims 1 to 3 characterized in that the second ports (15n) consist of one or more holes (15n) made just outside the flame port area (12a).

9. The burner according to any one of the claims from 1 to 6 characterized in that the second ports (15) are made in the casing (2, 102) starting at distances (L1, L2) from the ends of the tubular casing (2, 102).

10. The burner according to any one of the claims from 1 to 6 characterized in that the second ports (15t) are made in the said casing (2, 102) between the points defined by the distances (L1, L2) from the ends of the tubular casing (2, 102).

11. The burner according to any one of the claims from 1 to 6 characterized in that the width of the second ports (15, 15t, 15m), measured in the lengthways direction of the tubular casing (2, 102), is such that, during use, whatever the operating temperature of the burner (1) and whatever the degree of thermal expansion of the wall (13) that defines the lateral surface of the tubular casing (2, 102), the two adjacent edges of each second port (15, 15t, 15m) can never come into contact with each other.

12. The burner according to any one of the claims from 1 to 6 characterized in that the first flame ports consist of slits (14) parallel to each other and perpendicular to the longitudinal axis (3) of the casing (2, 102), the spacing between two consecutive second ports (15, 15t, 15m) being wider than the spacing between two consecutive first flame ports (14).

13. The burner according to claim 1 characterized in that the flame port area (12a) of the portion (12) has at least one group of second ports (15') arranged one after the other along a curved line

perpendicular to the longitudinal axis (3) of the casing (2, 102) and separated from each other by very small portions (15p) of the wall (13) defining the lateral surface of the casing (2, 102).

14. The burner according to claim 13 characterized in that it comprises a plurality of the said groups of second ports (15') parallel to each other and perpendicular to the longitudinal axis (3) of the casing (2, 102) and distributed along the flame port area (12a).

15. The burner according to claim 11 characterized in that the number of the said second ports (15'), the spacing between them and their width, measured in a direction parallel to the said axis (3), depend on the amount of expansion, during use, of the part of the casing (2, 102) in which the said first flame ports (14) are made and which is to be controlled and also on the design of the casing (2, 102), on the shape of the first flame ports (14), on the materials used and on the temperature conditions of the combustion chamber in which the burner is used.

16. The burner according to any one of the claims from 1 to 3 characterized in that the first flame ports (14) consist of small polygonal groups arranged in one or more rows or in chequered fashion.

17. The burner according to any one of the claims from 1 to 3 characterized in that the first flame ports (14) are circular in shape and arranged in one or more rows or in chequered fashion.

18. The burner according to any one of the claims from 1 to 3 characterized in that the first flame ports (14) consist of small polygonal groups combined with groups of circular ports arranged in one or more rows or in chequered fashion.

19. The burner according to any one of the claims from 1 to 18 characterized in that the casing (2) is tubular in shape and closed at both ends except for a port for letting in gas and air.

20. The burner according to claim 1 characterized in that the casing (2) is tubular in shape and closed at both ends except for a port for letting in gas and air and in that the said mixing means comprise a venturi tube (6) housed inside the casing (2) and extend along an axis parallel to the longitudinal axis (3) of the casing (2) itself; there being envisaged feeder means comprising a nozzle (10) extending to the tubular casing (2) and designed to inject a stream of gas at a pressure greater than atmospheric pressure into an end portion of the said venturi tube (6) and there being also envisaged in the tubular casing (2) a port for allowing air into the said venturi tube (6).

21. The burner according to claim 1 characterized in that the casing (2) is tubular in shape and closed at both ends except for a port for letting in gas and air and in that the said mixing means comprise premixing means (6p) located outside the tubular casing (2) and designed to inject a stream of gas mixed with air at a pressure greater than atmospheric pressure into the tubular casing (2) through an appropriate inlet port.

22. The burner according to any one of the claims from 1 to 18 characterized in that the said burner is of the modular blade type.

FIG.3

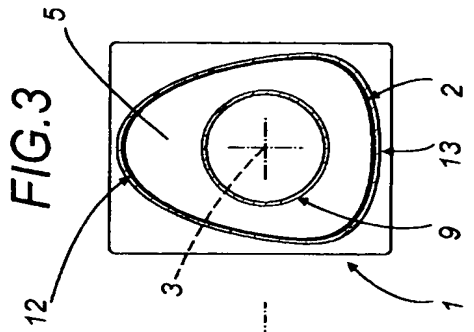


FIG.1

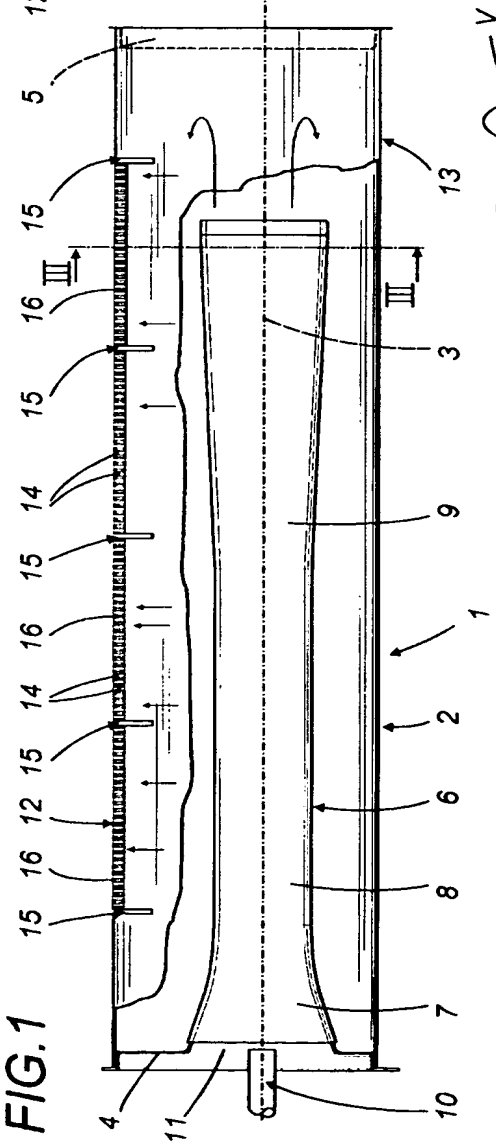


FIG.2

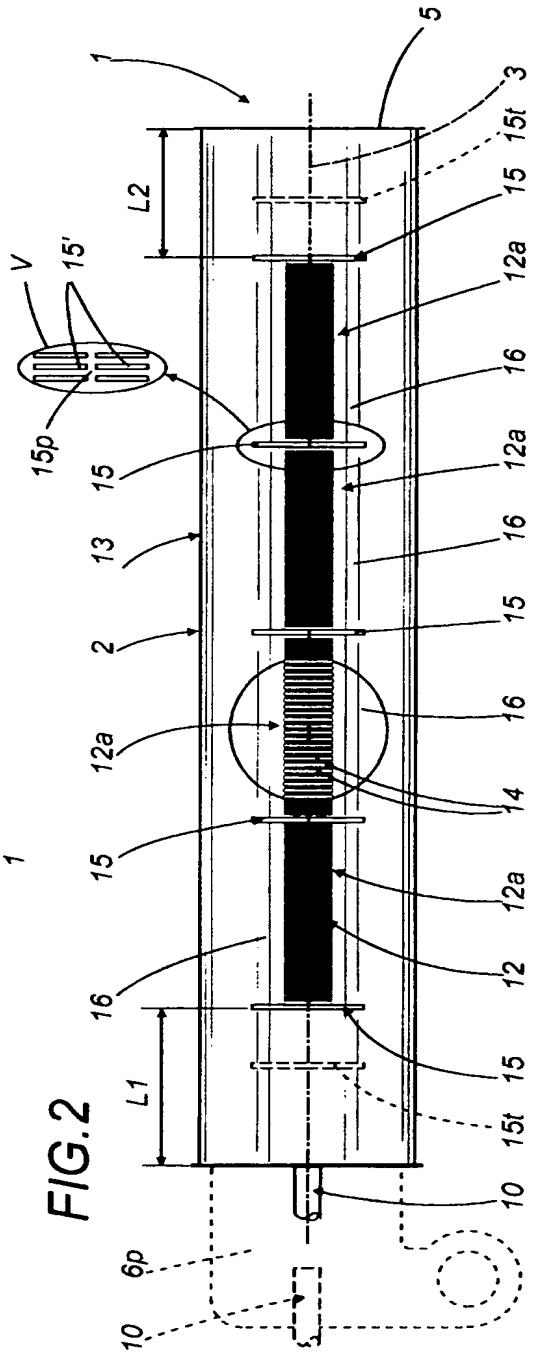


FIG.4

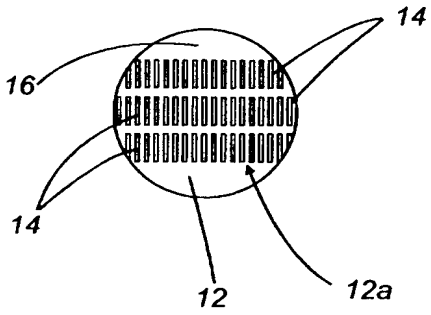


FIG.5

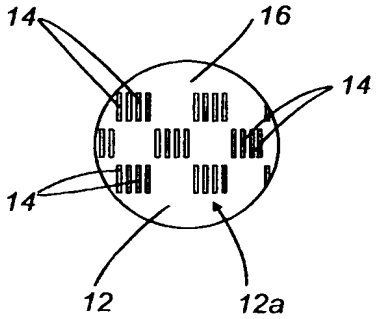


FIG.6

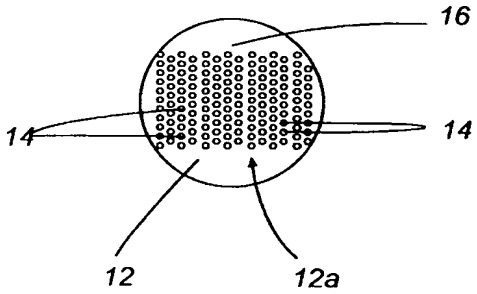


FIG.10

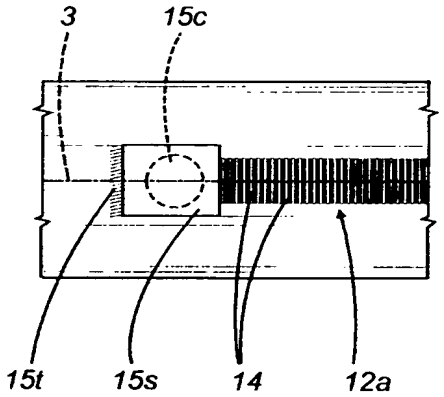


FIG.11

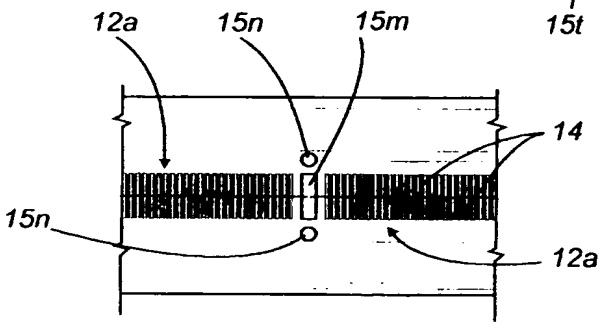


FIG.9

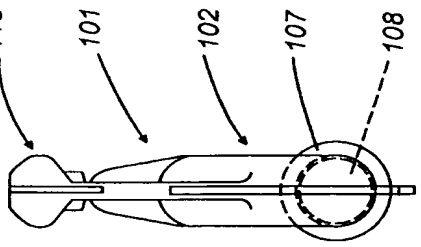


FIG.7

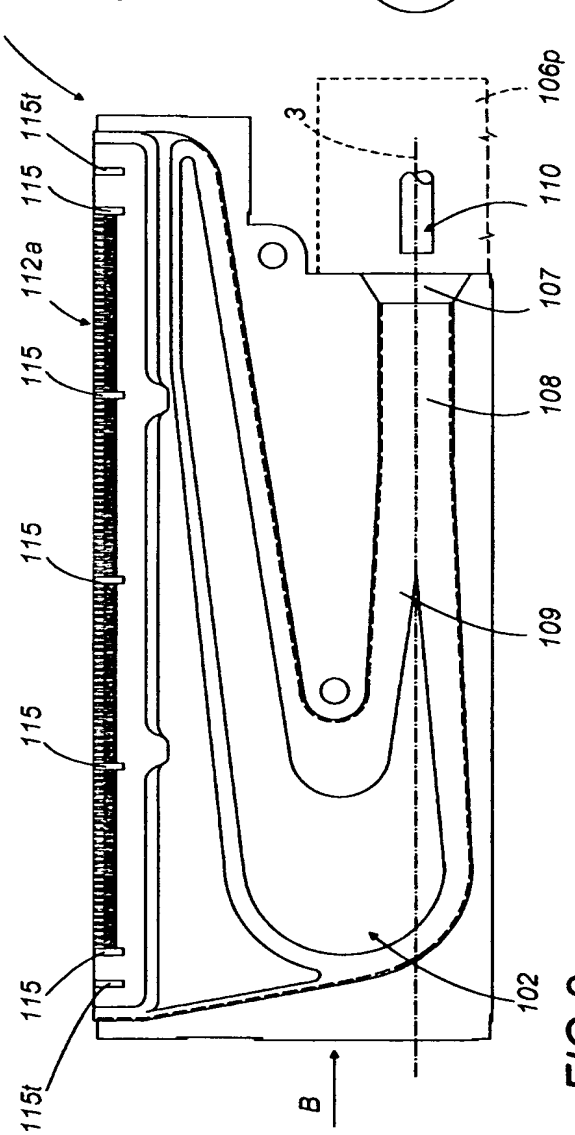
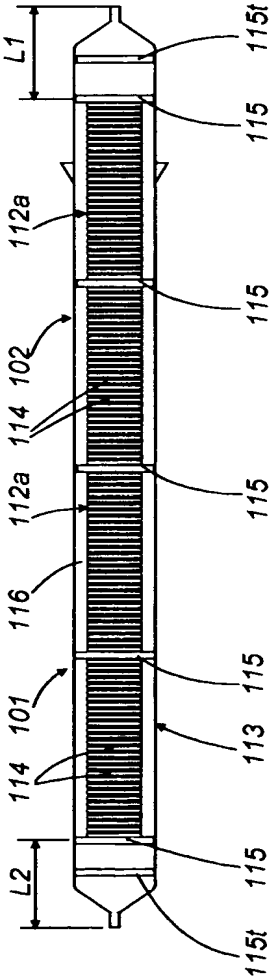


FIG.8



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EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0594

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	NL 8 801 383 A (NEFIT) * page 3, line 6 - page 4, line 12; figures 1,2 *	1-6,9, 11,12, 15-17	F23D14/58 F23D14/10
X	EP 0 695 911 A (WORGAS BRUCIATORI) * column 2, line 10 - column 2, line 18 * * column 2, line 54 - column 3, line 27 * * column 5, line 13 - column 5, line 40 * * figures 1-3,8,10 *	1-6,9, 12,16, 19,20,22	
X	DE 295 14 660 U (POLIDORO) * page 3, line 6 - page 3, line 27; figures 1-8 *	1-5,12, 19,20	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 April 1997	Phoa, Y

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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